



WORKSHEET

Probability Question – Tree Diagrams

Question Description: Question involves you constructing tree diagrams and making probability calculations from them. They can either ask you this directly or you must draw one to help you make calculations.

$$P(A \mid B) = \frac{P(A \cap B)}{P(B)}$$

Probability of event A
given B has occurred

Probability of event A occurred
and event B occurred

Probability of event B

QUESTIONS

Q1 s2016_p62

Ayman's breakfast drink is tea, coffee or hot chocolate with probabilities 0.65, 0.28, 0.07 respectively. When he drinks tea, the probability that he has milk in it is 0.8. When he drinks coffee, the probability that he has milk in it is 0.5. When he drinks hot chocolate he always has milk in it.

(i) Draw a fully labelled tree diagram to represent this information. [2]

(ii) Find the probability that Ayman's breakfast drink is coffee, given that his drink has milk in it. [3]

Q2 s2017_p61

Redbury United soccer team play a match every week. Each match can be won, drawn or lost. At the beginning of the soccer season the probability that Redbury United win their first match is $\frac{3}{5}$, with equal probabilities of losing or drawing. If they win the first match, the probability that they win the second match is $\frac{7}{10}$ and the probability that they lose the second match is $\frac{1}{10}$. If they draw the first match they are equally likely to win, draw or lose the second match. If they lose the first match, the probability that they win the second match is $\frac{3}{10}$ and the probability that they draw the second match is $\frac{1}{20}$.

- (i) Draw a fully labelled tree diagram to represent the first two matches played by Redbury United in the soccer season. [2]
- (ii) Given that Redbury United win the second match, find the probability that they lose the first match. [4]

Q3 w2017_p61

Over a period of time Julian finds that on long-distance flights he flies economy class on 82% of flights. On the rest of the flights he flies first class. When he flies economy class, the probability that he gets a good night's sleep is x . When he flies first class, the probability that he gets a good night's sleep is 0.9.

- (i) Draw a fully labelled tree diagram to illustrate this situation. [2]

The probability that Julian gets a good night's sleep on a randomly chosen flight is 0.285.

- (ii) Find the value of x . [2]
- (iii) Given that on a particular flight Julian does not get a good night's sleep, find the probability that he is flying economy class. [3]

Q4 w2017_p63

At the end of a revision course in mathematics, students have to pass a test to gain a certificate. The probability of any student passing the test at the first attempt is 0.85. Those students who fail are allowed to retake the test once, and the probability of any student passing the retake test is 0.65.

- (i) Draw a fully labelled tree diagram to show all the outcomes. [2]
- (ii) Given that a student gains the certificate, find the probability that this student fails the test on the first attempt. [4]

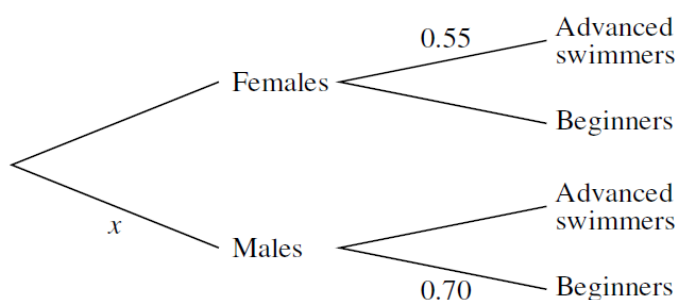
Q5 s2019_p63

Megan sends messages to her friends in one of 3 different ways: text, email or social media. For each message, the probability that she uses text is 0.3 and the probability that she uses email is 0.2. She receives an immediate reply from a text message with probability 0.4, from an email with probability 0.15 and from social media with probability 0.6.

- (i) Draw a fully labelled tree diagram to represent this information. [2]
- (ii) Given that Megan does not receive an immediate reply to a message, find the probability that the message was an email. [4]

Q6 s2018_p63

The members of a swimming club are classified either as 'Advanced swimmers' or 'Beginners'. The proportion of members who are male is x , and the proportion of males who are Beginners is 0.7. The proportion of females who are Advanced swimmers is 0.55. This information is shown in the tree diagram.



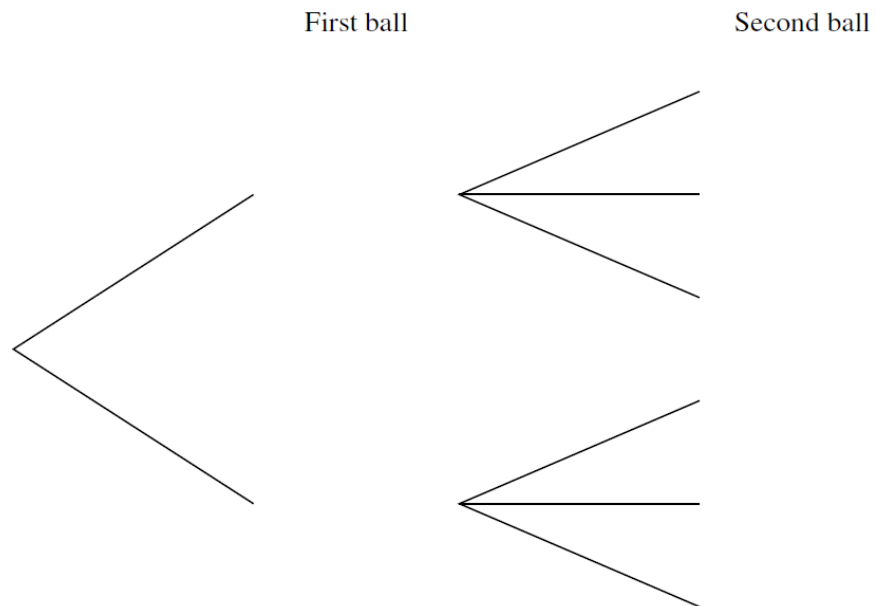
For a randomly chosen member, the probability of being an Advanced swimmer is the same as the probability of being a Beginner.

- (i) Find x . [3]
- (ii) Given that a randomly chosen member is an Advanced swimmer, find the probability that the member is male. [3]

Q7 w2018_p63

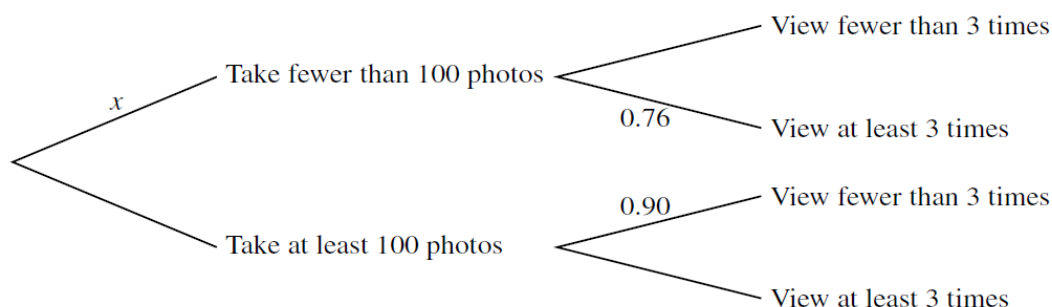
A box contains 3 red balls and 5 blue balls. One ball is taken at random from the box and not replaced. A yellow ball is then put into the box. A second ball is now taken at random from the box.

- (i) Complete the tree diagram to show all the outcomes and the probability for each branch. [2]



- (ii) Find the probability that the two balls taken are the same colour. [2]
- (iii) Find the probability that the first ball taken is red, given that the second ball taken is blue. [3]

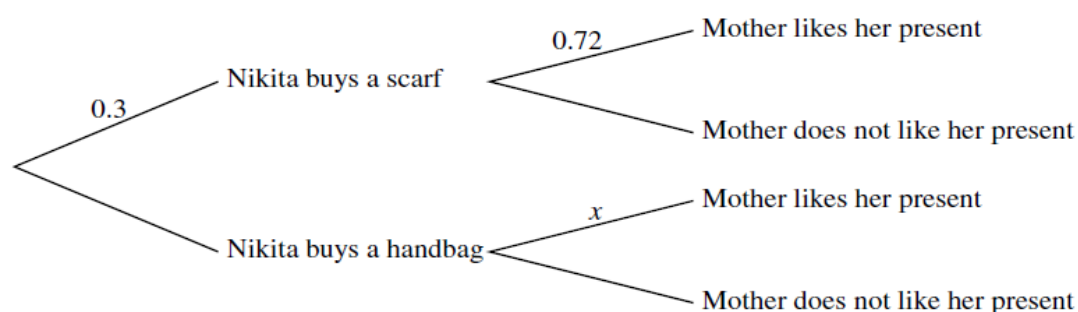
Q8 s2015_p61



A survey is undertaken to investigate how many photos people take on a one-week holiday and also how many times they view past photos. For a randomly chosen person, the probability of taking fewer than 100 photos is x . The probability that these people view past photos at least 3 times is 0.76. For those who take at least 100 photos, the probability that they view past photos fewer than 3 times is 0.90. This information is shown in the tree diagram. The probability that a randomly chosen person views past photos fewer than 3 times is 0.801.

- (i) Find x . [3]
- (ii) Given that a person views past photos at least 3 times, find the probability that this person takes at least 100 photos. [4]

Q9 s2015_p62



Nikita goes shopping to buy a birthday present for her mother. She buys either a scarf, with probability 0.3, or a handbag. The probability that her mother will like the choice of scarf is 0.72. The probability that her mother will like the choice of handbag is x . This information is shown on the tree diagram. The probability that Nikita's mother likes the present that Nikita buys is 0.783.

- (i) Find x . [3]
- (ii) Given that Nikita's mother does not like her present, find the probability that the present is a scarf. [4]

Q10 s2016_p61

The probability that the school bus is on time on any particular day is 0.6. If the bus is on time the probability that Sam the driver gets a cup of coffee is 0.9. If the bus is not on time the probability that Sam gets a cup of coffee is 0.3.

- (i) Find the probability that Sam gets a cup of coffee. [2]
- (ii) Given that Sam does not get a cup of coffee, find the probability that the bus is not on time. [3]

Q11 w2016_p62

When Anya goes to school, the probability that she walks is 0.3 and the probability that she cycles is 0.65; if she does not walk or cycle she takes the bus. When Anya walks the probability that she is late is 0.15. When she cycles the probability that she is late is 0.1 and when she takes the bus the probability that she is late is 0.6. Given that Anya is late, find the probability that she cycles. [5]

Q12 s2017_p62

During the school holidays, each day Khalid either rides on his bicycle with probability 0.6, or on his skateboard with probability 0.4. Khalid does not ride on both on the same day. If he rides on his bicycle then the probability that he hurts himself is 0.05. If he rides on his skateboard the probability that he hurts himself is 0.75.

- (i) Find the probability that Khalid hurts himself on any particular day. [2]
- (ii) Given that Khalid hurts himself on a particular day, find the probability that he is riding on his skateboard. [2]

Q13 w2017_p61

A shop sells two makes of coffee, Café Premium and Café Standard. Both coffees come in two sizes, large jars and small jars. Of the jars on sale, 65% are Café Premium and 35% are Café Standard. Of the Café Premium, 40% of the jars are large and of the Café Standard, 25% of the jars are large. A jar is chosen at random.

- (i) Find the probability that the jar is small. [2]
- (ii) Find the probability that the jar is Café Standard given that it is large. [3]

Q14 w2019_p61

When Shona goes to college she either catches the bus with probability 0.8 or she cycles with probability 0.2. If she catches the bus, the probability that she is late is 0.4. If she cycles, the probability that she is late is x . The probability that Shona is not late for college on a randomly chosen day is 0.63. Find the value of x . [3]

Q15 w2019_p62

Benju cycles to work each morning and he has two possible routes. He chooses the hilly route with probability 0.4 and the busy route with probability 0.6. If he chooses the hilly route, the probability that he will be late for work is x and if he chooses the busy route the probability that he will be late for work is $2x$. The probability that Benju is late for work on any day is 0.36.

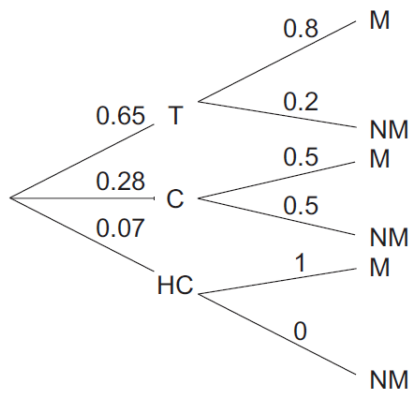
(i) Show that $x = 0.225$. [2]

(ii) Given that Benju is not late for work, find the probability that he chooses the hilly route. [3]

ANSWERS

Q1

(i)



M1

Correct shape with either one branch after HC or 2 branches with 0 prob seen correct
Labelled and clear annotation

A1 [2]

All probs correct

(ii)

$$\begin{aligned}
 P(C \mid \text{milk}) &= \frac{P(\text{coffee} \cap \text{milk})}{P(\text{milk})} \\
 &= \frac{0.28 \times 0.5}{0.65 \times 0.8 + 0.28 \times 0.5 + 0.07(\times 1)} \\
 &= \frac{0.14}{0.73} \\
 &= 0.192
 \end{aligned}$$

M1

Attempt at $P(\text{coffee} \cap \text{milk})$ as a two-factor prod only seen as num or denom of a fraction

M1

Summing appropriate three 2-factor products seen anywhere (can omit the 1)

A1 [3]

Correct answer oe

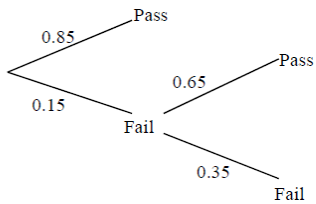
Q2

(i)		M1 Correct shape i.e. 3 branches then 3 by 3 branches, labelled and clear annotation Condone omission of lines for first match result providing the probabilities are there.
		A1 All correct probs with fully correct shape and probs either fractions or decimals not 1.5/5 etc.
(ii)	Total: $P(L_1 \text{ given } W_2) = \frac{P(L_1 \cap W_2)}{P(W_2)}$ $= \frac{1/5 \times 3/10}{3/5 \times 7/10 + 1/5 \times 1/3 + 1/5 \times 3/10}$ $= \frac{3/50}{41/75} = 9/82 (0.110)$ Total:	2 M1 Attempt at $P(L_1 \cap W_2)$ as a two-factor prod only as num or denom of a fraction M1 Attempt at $P(W_2)$ as sum of appropriate 3 two-factor probs OE seen anywhere A1 Unsimplified correct $P(W_2)$ num or denom of a fraction A1 4

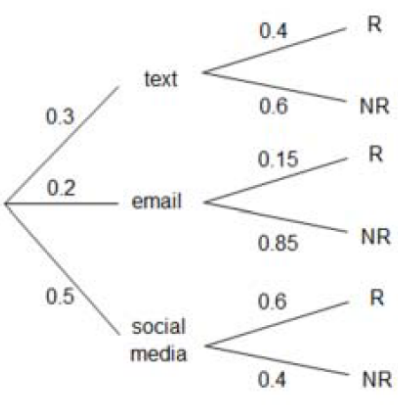
Q3

(i)		B1 Must see at least 4 probs correct including one with an x in, correct shape B1 Shape, clear labels/annotation and all probs correct
(ii)	$0.82x + 0.18 \times 0.9 = 0.285$ $x = 0.15$	2 M1 Eqn with x in, two 2-factors on one side A1 2
(iii)	$P(E \text{not GNS}) = \frac{P(E \cap \text{not GNS})}{P(\text{not GNS})}$ $= \frac{0.82 \times 0.85}{1 - 0.285} = 0.975$	M1 Attempt at $P(E \cap \text{not GNS})$ seen as num or denom of fraction M1 Attempt at $P(\text{not GNS})$ seen anywhere A1 Correct answer 3

Q4

(i)		M1	Correct shape
		A1	All correct labels and probabilities
		2	
(ii)	$P(F \mid P) = \frac{P(F \cap P)}{P(P)}$	M1	P(P) consistent with their tree diagram seen anywhere
	$= \frac{0.15 \times 0.65}{0.85 + 0.15 \times 0.65}$ or $\frac{0.15 \times 0.65}{1 - 0.15 \times 0.35}$	A1	Correct unsimplified P(P) seen as num or denom of a fraction
	$= \frac{0.0975}{0.9475}$	M1	P(F ∩ P) found as correct product or consistent with their tree diagram seen as num or denom of a fraction
	$= \frac{39}{379} = 0.103$	A1	
		4	

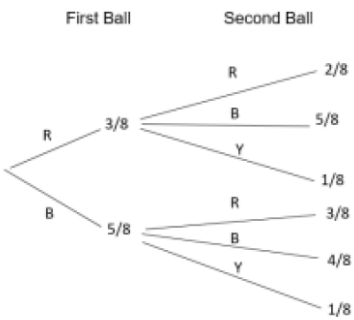
Q5

(i)		B1	Fully correct labelled tree with correct probabilities for 'Send'
		B1	Fully correct labelled branches with correct probabilities for the 'reply'
(ii)	$P(email NR) = \frac{P(email \cap NR)}{P(NR)} = \frac{0.2 \times 0.85}{0.3 \times 0.6 + 0.2 \times 0.85 + 0.5 \times 0.4}$	2 M1	$P(email) \times P(NR)$ seen as numerator of a fraction, consistent with <i>their</i> tree diagram
	$= \frac{0.17}{0.18 + 0.17 + 0.2} = \frac{0.17}{0.55}$	M1	Summing three appropriate 2-factor probabilities, consistent with <i>their</i> tree diagram, seen anywhere 0.55 oe (can be unsimplified) seen as denom of a fraction
	$= 0.309, \frac{17}{55}$	A1	
		A1	Correct answer
		4	

Q6

(i)	$(1-x)$ and 0.45 (or 0.3)	B1	Seen, either on tree diagram or elsewhere
	Beginners: $0.7 \times x + '0.45' \times '(1-x)' = 0.5$ Or Advanced: $'0.3' \times x + 0.55 \times '(1-x)' = 0.5$ Or $0.7 \times x + '0.45' \times '(1-x)' = '0.3' \times x + 0.55 \times '(1-x)'$	M1	One of the three correct probability equations
	$x = 0.2$ oe	A1	Correct answer
	Total:	3	
(ii)	$P(M A) = \frac{P(M \cap A)}{P(A)} = \frac{0.2 \times 0.3}{0.5}$	M1	'i' $\times$ 0.3 as num or denom of a fraction
		M1	0.5 (or $(1 - 'i') \times 0.55 + 'i' \times 0.3$ unsimplified) seen as denom of a fraction
	$= 0.12 \left(\frac{3}{25} \right)$	A1	Correct answer
	Total:	3	

Q7

(i)		B1	Fully correct labelled tree and correct probabilities for 'First Ball'
		B1	Correct probabilities (with corresponding labels) for 'Second Ball'
		2	
(ii)	$P(RR) + P(BB) = 3/8 \times 2/8 + 5/8 \times 4/8 = 3/32 + 5/16$	M1	Correct unsimplified expression from their tree diagram, $\Sigma p = 1$ on each branch
	$= 13/32$ (0.406)	A1	Correct answer
		2	
(iii)	$P(RB) = 3/8 \times 5/8 = 15/64$	M1	$P(1st \text{ ball red}) \times P(2nd \text{ ball blue})$ from their tree diagram seen unsimplified as numerator or denominator of a fraction Allow $\Sigma p \neq 1$ on each branch
	$P(B) = 3/8 \times 5/8 + 5/8 \times 4/8 = 35/64$	M1	Correct unsimplified expression for $P(B)$ from their tree diagram seen as denominator of a fraction. Allow $\Sigma p \neq 1$ on each branch
	$P(R B) = P(RB) / P(B) = (15/64) \div (35/64) = 3/7$ (0.429)	A1	Correct answer
		3	

Q8

(i)	$(1-x)0.9 + x \times 0.24 = 0.801$	M1	Eqn with sum of two 2-factor probs = 0.801
	$x = 0.15$	A1 A1 [3]	Correct equation Correct answer
(ii)	$P(\geq 100 \text{ times given } \leq 3 \text{ views})$	B1	0.85×0.1 seen on its own as num or denom of a fraction
	$\frac{P(\geq 100 \text{ times} \cap \geq 3 \text{ views})}{P(\geq 3 \text{ views})} =$	M1	Attempt at $P(\geq 3 \text{ views})$ either $(0.85 \times p_1 + 0.15 \times p_2)$ or $1 - 0.801$ seen anywhere
	$\frac{0.85 \times 0.1}{0.85 \times 0.1 + 0.15 \times 0.76 \text{ or } 1 - 0.801}$	A1	Correct unsimplified $P(\geq 3 \text{ views})$ as num or denom of a fraction
	$= 0.427$	A1 [4]	Correct answer

Q9

(i)	$0.3 \times 0.72 + 0.7 \times x = 0.783$	M1	Eqn with sum of two 2-factor probs = 0.783
	$x = 0.81$	A1 A1 3	Correct equation Correct answer
(ii)	$P(S \text{ given not like}) = \frac{P(S \cap NL)}{P(NL)}$	B1	0.3×0.28 seen on its own as num or denom of a fraction
	$= \frac{0.3 \times 0.28}{0.3 \times 0.28 + 0.7 \times 0.19 \text{ or } 1 - 0.783}$	M1	Attempt at $P(NL)$ either $(0.3 \times p_1) + (0.7 \times p_2)$ or $1 - 0.783$ seen anywhere
	$= 0.387 \text{ (12/31)}$	A1	Correct unsimplified $P(NL)$ as num or denom of a fraction
		A1 4	Correct answer

Q10

(i)	$P(\text{cup of coffee}) = 0.6 \times 0.9 + 0.4 \times 0.3$	M1	Summing two 2-factor probabilities
	$= 0.66$	A1 [2]	Correct answer accept 0.660
(ii)	$P(\text{Not on time} \mid \text{no cup of coffee})$	M1	0.4×0.7 seen as num or denom of a fraction
	$= \frac{P(\text{not on time} \cap \text{no cup})}{P(\text{no cup})} = \frac{0.4 \times 0.7}{1 - 0.66}$	M1	Attempt at $P(\text{no cup})$ as $0.1 \times p_1 + 0.7 \times p_2$ or as $1 - (i)$ seen anywhere
	$= \frac{0.28}{0.34} = 0.824$	A1 [3]	

Q11

$P(C \text{ given } L) = \frac{P(C \cap L)}{P(L)}$ $= \frac{0.65 \times 0.1}{0.65 \times 0.1 + 0.3 \times 0.15 + 0.05 \times 0.6}$ $= \frac{0.065}{0.14}$ $= 0.464, \frac{13}{28}$	M1	$P(C \cap L)$ seen as num or denom of a fraction
	A1	Correct unsimplified $P(C \cap L)$ as numerator
	M1	Summing three 2-factor products seen anywhere
	A1	0.14 (unsimplified) seen as num or denom of a fraction
	A1 [5]	oe

Q12

(i)	$P(H) = P(BH) + P(SH) = 0.6 \times 0.05 + 0.4 \times 0.75$	M1	Summing two 2-factor probs using 0.6 with 0.05 or 0.95, and 0.4 with 0.75 or 0.25
	$= 0.330 \text{ or } \frac{33}{100}$	A1	Correct final answer accept 0.33
	Total:	2	
(ii)	$P(S H) = \frac{P(S \cap H)}{P(H)} = \frac{0.4 \times 0.75}{0.33} = \frac{0.3}{0.33}$	M1 FT	Their $\frac{P(S \cap H)}{P(H)}$ unsimplified, FT from (i)
	$= \frac{10}{11} \text{ or } 0.909$	A1	
	Total:	2	

Q13

(i)		B1	Must see at least 4 probs correct including one with an x in, correct shape
		B1	Shape, clear labels/annotation and all probs correct
(ii)	$0.82x + 0.18 \times 0.9 = 0.285$	M1	Eqn with x in, two 2-factors on one side
	$x = 0.15$	A1	
		2	
(iii)	$P(E \text{not GNS}) = \frac{P(E \cap \text{not GNS})}{P(\text{not GNS})}$	M1	Attempt at $P(E \cap \text{not GNS})$ seen as num or denom of fraction
		M1	Attempt at $P(\text{not GNS})$ seen anywhere
	$= \frac{0.82 \times 0.85}{1 - 0.285} = 0.975$	A1	Correct answer
		3	

Q14

$0.8 \times 0.6 + 0.2(1-x) = 0.63$	M1	Equation of form $0.8 \times A + 0.2 \times B = C$, A,B involving $1-x$ and 0.6 or 0.4 and $C = 0.63$ or 0.37
$0.2x = 0.05$	M1	Correct unsimplified equation
$x = 0.25$	A1	
Alternative method for question 1		
$0.8 \times 0.4 + 0.2x = 1 - 0.63$	M1	Equation of form $0.8 \times A + 0.2 \times B = C$, A,B involving x and 0.6 or 0.4 and $C = 0.63$ or 0.37
$0.2x = 0.05$	M1	Correct unsimplified equation
$x = 0.25$	A1	
	3	

Q15

(i)	$0.4x + 0.6 \times 2x = 0.36$ or $0.4(1-x) + 0.6(1-2x) = 0.64$	M1	$0.4a + (1-0.4)b = 0.36$ or 0.64, a, b terms involving x
	$1.6x = 0.36$ $x = 0.225$	A1	Fully justified by algebra AG
(ii)		2	
	$P(H L) = \frac{0.4(1-x)}{1-0.36} = \frac{0.4 \times (1-0.225)}{0.64} = \frac{0.4 \times 0.775}{0.4 \times 0.775 + 0.6 \times 0.55}$	M1	Correct numerical numerator of a fraction. Allow unsimplified.
		M1	Denominator 0.36 or 0.64. Allow unsimplified.
	$\frac{31}{64}$ or 0.484	A1	
		3	